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EFFECTIVENESS OF SOVIET BRANCH SCIENTIFIC RESEARCH INSTITUTES

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The fulfillment of complex and responsible tasks, placed by the Communist Party and the Soviet Government before various branches of the national economy, and the continuous increase of technological levels in industry, transport, and in agricultural production are impossible without the extended development of scientific research and experimental design work. This work must be expeditiously divided between plants and enterprises on the one hand, and specially created organizations -- branch scientific research institutes -- on the other hand.

There is a large network of organized scientific research institutes in the USSR. The government spends enormous sums on the training of scientific cadres, and on building and equipping experimental laboratories and shops. Scientific workers are accorded all the conditions necessary for their fruitful work.

The personnel of scientific research enterprises are developing and introducing new models of machines and instruments, advanced technological processes, automatized production lines, and high productivity mechanization of laborious agricultural and building operations. However, besides the successfully operating scientific research establishments there are also institutes whose work does not meet the increased requirements of the national economy and yields no appreciable practical results.

Periodicals contain articles criticizing the work of some scientific research establishments. They note the complete separation from reality in the subjects covered, the extreme slowness in the solution of projects, the inadequate quantity, and sometimes even the complete lack of the productive introduction of the projects, etc. However, these deficiencies are rarely accompanied by an analysis of their causes or concrete suggestions for their elimination.

Since many of the matters pertaining to the improvement in the operation of the branch scientific research institutes are common to many industries and, since many of these matters are complex, it is well that they be thoroughly discussed in the press so that they attract the attention of technical persons, publicize the opinions of many specialists, and, therefore, contribute toward the speedy and thorough solution of these pregnant problems by directorial organizations.

This article examines some essentially important, and primarily organizational, problems which are characteristic of machine building scientific research institutes.

Projects and Planning

Branch institutes generally operate on an annual subject plan. Individual, more complex problems, the solution of which requires several years, are included as continuing items in the plan.

Much attention and labor are given to planning scientific research and experimental work. Plans are often compiled and discussed (scientific-technical councils of departments, institutes, main administrations, and ministries) long before the beginning of the new production year.

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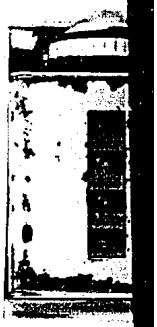

The selection of the most industrially relevant subjects of course requires serious effort. Reality, however, forces certain changes in even the most carefully laid plans. During the course of the year the institutes inevitably receive a multitude of supplementary "above-plan" or "extra-plan" requirements from various organizations and primarily from the ministries concerned; these requirements frequently surpass the original plan projects in their importance, complexity, and laboriousness. It is only possible to make very approximate estimates of "extra-plan" requirements when compiling the plan.

However, the large work schedules of branch institutes permits the planning of only some financial and material reserves; it is impossible to foresee the types and qualifications of specialists to be needed. Therefore, the new projects received during the year may be completed only by excluding parts of the basic plan (the so-called corrective planning) or by overloading and thereby reducing quality, decreasing the degree of research, or extending due dates of plan or extra-plan projects (or both). Hence, it follows that despite the inevitability of extra-plan work, it is necessary to strive toward a decrease in their quantity. A large percentage of such projects must be regarded as a result of major planning failures, an inadequate familiarity with the existing situation, and a lack of perspective in the development of the field which the given institute serves. Both the scientific research establishments and their directing organizations (primarily the technical administrations and ministry and main administration departments) must bear the responsibility for this.

The situation will be improved only when the ministries devote considerably more attention to future and current planning of scientific research and experimental design projects and when the plans of branch institutes will be based on concrete technical plans for the development of corresponding branches of industry, transport, or agriculture.

The so-called multithemes are inherent in the thermatic plans of institutes, serving the complex mass production machine-building industries (such as automobile building, tractor building).

It is rightly considered a serious plan deficiency but, despite this, many institutes have for years failed to rid themselves of it and to compile a plan of a small number of industrially important themes. Why should this be so?

The causes of the multitheme plans may be varied. The first and principal cause is in the multiplicity of problems and questions posed by industry, particularly by its more complex and highly developed sections. If this reason be ignored and subject matter be mechanically limited, then it is inevitable that industrial interests will be violated, for the technical advancement of which it is necessary to continually pose and resolve ever new problems of increasing complexity.

The second cause of this multiplicity often lies in the tendency of individual scientific workers, managers of institute subdivisions, and other people to introduce themes into the operation plans which are of personal interest to them (in their own narrow field of specialization), regardless of their applicability to industry and the expediency of their being studied at the given time. The development of certain themes continues for years; others are included in the plan under the pretext that they are of interest to some plant or other at the given time; still others come up at the behest of inventors or rationalizers from among the workers at the institute or elsewhere. The work being conducted on the basis of such proposals is often extensive and highly expensive. Therefore, it is very important to conduct a thorough preliminary analysis of

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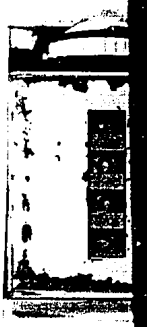

the technical basis and perspectives of themes proposed for study prior to their inclusion in the operational plan of the institute. There are many instances where the failure in following such a procedure resulted in a useless expenditure of effort and funds over a period of some years, after which the projects were abandoned as being industrially unimportant and perspectiveless.

There is no need to prove that a multitheme plan leads to dispersal of effort, to delays in the solution of basic, important problems, and sharply reduces the over-all effectiveness of the operation of scientific research establishments. The effort to overcome multiplicity of themes must be carried out by the decisive curtailment of projects insufficiently well-grounded.

At the same time difficulties which arise as a consequence of the multiplicity of problems which are of actual importance to industry must be overcome, as was pointed out, not by a mechanical curtailment of the problem but by bringing into conformance the capabilities of the branch institutes and the industrial demands. It cannot be denied that individual complex branches of machine building at present have a disproportion between the rate of development of the industrial enterprises and the capabilities of the corresponding branch institutes. The removal of this disproportionality must be regarded as one of the very important problems, the solution of which cannot be delayed.

In planning scientific research work it is necessary to take into account the economic effect which any work would have on industry or on the national economy as a whole. The technical-economic effect, be it direct, or as is often the case in science, indirect, must in the majority of cases serve as ultimate criterion, determining the necessity for the projects and the order in which they should be carried out. However, it is only very rarely that one finds a serious economic basis for projects in the project schedules of scientific research establishments.

Let us note that specialists who are capable of making an economic analysis of technical problems are not included on the staffs of many branch institutes. And, should not economic science be attracted to the field of scientific research work in industry, so that it may give real and concrete aid on the choice of projects, in determining expedient capital investments in scientific research establishments, on the proportion of appropriations to individual projects, etc.?

If matters of national economic significance and economic effectiveness were to be a greater fundamental criterion in the selection of projects and if they were to determine the whole nature of branch scientific research institute operations, then probably such important problems as for instance a reliable method of protecting agricultural machine parts, automobile chassis, and metal structures, etc., from corrosion, or the problem of adapting automotive transport to agricultural conditions, or finally, the spare parts requirements of mass produced machines and equipment, would not be developed, as at present, on an insufficient and too slow a scale, being protracted indefinitely, but would be solved radically, with every means available to modern technology.

Structure of Scientific Research Establishments

Scientific research work in the field of technology is conducted by institutes of the Technical Department of the Academy of Sciences, by branch scientific research institutes and plant laboratories or by experimental design departments. The necessary coordination in the work of all the subdivisions of this complex system, as for instance, a single complex plan for individual problems or branches of industry, is not easy to attain. Therefore, together with problems on one question there is often a parallelism with problems on another question. The multiplicity of stages hampers the introduction of completed projects into industry.

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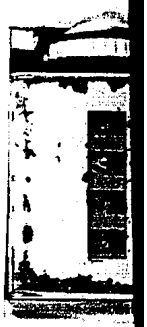


Experience shows that when branch and academy institutes work in parallel on closely allied problems, the level of the work done by the institutes does not differ so much as to justify the inevitable dispersion of effort and materials, which only deters realistic aid to industry. It may be considered that the academy organizations must work only on matters of great significance; but neither can the branch institutes refrain from working on significant problems: therefore, in many cases it is almost impossible to delineate clearly the projects of the individual institutes.

Consequently, the matter as to which branches of technology should have academic institutes created and which ones should have branch institutes developed (and of course have major scientists associated with them) cannot be decided once and for all. This question must be critically re-examined as often as is required by the circumstances of the given phase of development of the corresponding branch of the national economy.

OKB, SKB, EKB are designations for the "particular," "special," and "experimental design" bureaus, created under the branch institutes and plants or existing as independent organizations and having as their purpose the solution of individual problems or the development of some objective or other.

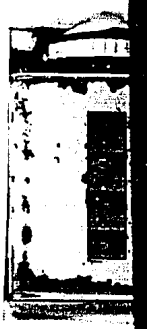
Such autonomous organizations may, in our opinion, be justified only in exceptional, "particular" cases. Among the deficiencies of such organizations are generally the weak production and experimental resources (and in the event of large resources, they are not fully utilized), and the lack of a complete staff of specialists to see a project through its entire cycle (design and calculation, manufacture of models of the machines, their testing and aligning, design of industrial structures, etc.).

In the formulation of complex projects, a corresponding complication of the structure of the OKB and SKB becomes unavoidable. New specialized groups on the different phases of the project, testing laboratories, etc., are constantly being organized. As a result the KB can expand to the magnitude of a new institute, which necessitates appropriate expenses and many additional specialists.

It is characteristic that even if an OKB is organized under a branch institute, then in the bureau the structure of many subdivisions of the institute has to be limited. Thus, in one of the existing OKBs under a machine-building branch institute there are designers, calculators, experimenters, equipment specialists, etc. Experience shows that since there are very few people in each specialty, actually one each, this OKB is not capable of the comprehensive solution of those problems which arise in the course of its work. Therefore, the investigations are prolonged and their early completion can scarcely be expected (by completion is meant the fulfillment of the project to the stage where it may be introduced into actual production).

Modern technology is based upon thorough specialization. The development of almost any machine in the machine-building branch institutes must have the participation of sufficiently large groups or laboratories (for instance laboratories on gear transmission, sliding bearings, roller bearings, and other machine elements), as well as specialists in machine design, metallographers, technologists, testers, instrument specialists, etc. It is clear that only a large organization is in a position to work on major problems.

It may perhaps be expedient, in assigning new projects to institutes (and not to individual design bureaus), to organize specific bureaus under them for the given project, limiting their functions to the purely design part of the operation.



However, even the design field has at present become more complex, with the designers specializing in individual assemblies of complex machines(in tractor-building, for instance, they may specialize in engines, undercarriages, reducers, gear boxes, etc.; in automobile building, on engines, transmissions, undercarriages, steering mechanisms, bodies, etc.). Consequently, even the design aspects of the project must be performed not in isolated bureaus but in large design shops having specialized groups in the various machine assemblies. One of these groups (and not an OKB) can be designated as the lead group and may be assigned the general over-all design of the new machine as well as the organizational and technical liaison of the specialized groups.

Thus the tendency of individual designers, suggesters, and inventors to set up autonomous organizations to develop their inventions or projects frequently run counter to the state interests and may only prove a liability to the very goal for which the OKB, SKB, or EKB organizations are set up.

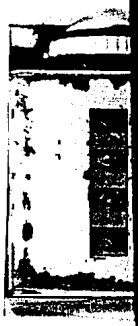
We are also faced with the conclusion that if the scientific research institute in a particular branch of industry cannot take upon itself the development of one or more new projects or problems as a result of insufficient resources, i.e., a lack of personnel, space, equipment, deficiencies in experimental production experience, etc., then the answer must be sought not in the creation of some new organizations of the above-mentioned type (which only leads to a further diffusion of specialists and an ineffective outlay of state funds), but in a harmonious development of the corresponding branch institute to the level which would make it capable of meeting the requirements of industry.

Cadres and Labor Wages

In scientific research work, more than anywhere else, the success of operations depends primarily upon the personnel, their preparation, creative initiative, purposefulness, and perseverance in the solution of assigned problems. Therefore, the supplying of institutes with specialists, and especially young specialists, must be based on careful individual selection with consideration given to the specialized requirements of the scientific research institutes. On the quality of the selection will depend the extent of the subsequent screening out of specialists accidently assigned to research work outside of their interests (except that stemming from material stimulus) or field of specialization.

A one-sided approach in the assignment of young specialists may be manifested in having persons who completed certain educational institutes sent to corresponding research establishments; for instance, machine builders may be sent to machine-building scientific research institutes, chemists to chemical institutes; petrologists to petroleum institutes, etc. Meanwhile it is known that, for instance, machine-building scientific research institutes require, although to a lesser degree, highly qualified mathematicians, fuel and oil specialists, and precision instrument specialists, as well as chemists, metallographers, engineer-economists, etc. The institutes of the petroleum industry, in turn, use mechanical engineers, mechanics, combustion engineers, and other specialists well acquainted with machines using petroleum products.

Unfortunately the necessity for such mutual exchange of specialists in various industries is not given sufficient consideration by the organs which assign specialists to the various scientific research institutes. Therefore, the unorganized "requisitioning" of young engineers and technicians having specialities unrelated to the principal interests of the branch institutes is still a matter which is difficult, troublesome, and frequently fruitless. And yet the resolution of this matter is not so difficult and requires no complex organizational measures.



In the scientific research institutes as well as in industry and agriculture, proper payment for services rendered plays an important part in the organization and utilization of personnel. However, this matter is still considerably disorganized. It is sufficient to glance at the so-called systems, i.e., systems of wage payments to workers in the branch institutes. It is almost impossible to find two branch institutes doing similar work, but subordinate to different ministries, paying equal wages for equal work. This results in high personnel turnover, and can in no wise be justified or explained by weighty arguments. The financial organs, instead of showing some initiative in bringing about order in this field and regulating the question on a nationwide scale, are concerning themselves only with perpetuation of the existing situation.

Comrade N. M. Shvernik, chairman of the VTsSPS (All-Union Council of Trade Unions), spoke of this disorganization in wage payments in his report to the 11th Conference of Trade Unions. However, there has been no visible effect of the trade unions taking the required measures to resolve this matter.

An important stimulant is the system of giving premiums for plan overfulfillments, for high quality scientific work, and for their introduction into production.

There is no information at our disposal as to whether there exist any systems for awarding prizes which have been especially developed for definite branch institutes and specifically planned for them. Nevertheless, we know that in a number of institutes there are systems used which were instituted for work of a purely design nature and which are only capable of being artificially utilized in stimulation of all of the diverse research and experimental work being done. This creates many inconveniences and complications and lowers the effectiveness of the prize system. Nonetheless, neither the labor nor trade union organizations are yet fulfilling their direct responsibility of developing systems for the awarding of prizes or of making them conform with the characteristics of the institutes for which they are intended.

There are also very serious shortcomings in the piece-rate pay system, which is used in experimental production, i.e., for building experimental machine models, instruments, and other items. As we know, in the manufacture of unit models or small experimental lots of new machines, as compared with serious production, there generally occur many nonrepeated operations and processes. The assignment of norms in such experimental production work suffers from inaccuracies as a result of the impossibility of a systematic correction of norms in the multiple repetitions of the same operations.

To assure appropriate earnings by highly qualified experimental production workers, the piecework system of wages is used in a distorted forms. The worker is paid in a more or less stable monthly wage with small differences one way or the other and "normalized" work orders are formulated in order to guarantee the wage indicated. Under this system there inevitably occurs repeated "overfulfillment" of the worker's norms in the time alloted for the task fulfillment. It is clear that such a system, which may in truth be called fictitious piecework, not only fails to stimulate but even slows down increases in the productivity of labor. The time has come to ask how these conditions may be improved. Perhaps it would be well to introduce a rate system of wages into experimental production with awards for high quality and high speed work.

Experimental Equipment and Apparatus

Modern research methods are almost always related to the use of rather complex and nonstandard (i.e., not on the market) experimental equipment and measuring apparatus.

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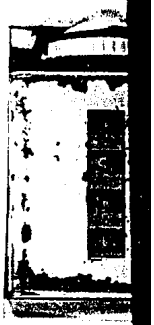

In setting up some new research projects and developing the methodology there is often a need also to create new experimental equipment. The length of time it takes to prepare the equipment determines to a large extent the length of time required to carry out the investigation as a whole. Therefore, the need for a modern branch scientific research institute to have its own instrument-building facility is obvious.

As a rule the institute should have a bureau or a group for equipment design, i.e., stands and instruments, work or instrument-building shops, and groups for the servicing and use of precision instruments. However, these facilities do not always correspond to the requirements of the research subdivision of the institute.

If the instrument construction facility of the institute is not up to par, recourse is made to a "decentralized" solution of the apparatus supply problem. Each investigator or research group begins to develop the necessary apparatus itself and, of course, thereby has to study the generally complex field of instrument building. Thus there occurs a sort of overqualifications of specialists with a considerable expenditure of time, frequently years, on this phase of the work. Consequently the researcher, say a mechanical engineer, becomes an electronic instrument designer for a long time, an automotive tractor or machine specialist becomes a lay specialist on tensiometric methods of determining stress in machine parts, etc.

Such "conversions" can scarcely be considered expedient where fruitful work in a particular technological field requires highly-qualified specialists in that field, i.e., where specialization is required and not the retraining of personnel in the other phases attending their investigation.

Engineers and especially scientific machine-building workers must be well orientated in measurement technology. However, their principal stress must be on matters appropriate to their specialty and field (engine specialist: engine design and its operation; machine builder: machine cutting, tools, kinematics, and machine design; etc.). The investigator can and must be qualified to specify the principal characteristics and specifications of apparatus, based upon accepted methods of investigation and to know the use of measuring techniques. However, the shop design of instruments and stands, and their preparation and alignment, must be done by special instrument-building subdivisions working in liaison with the requester. The path of least resistance, such as the above-mentioned "decentralization" of instrument-building operations, is one of the fundamental causes for extreme protraction of scientific investigations and must be condemned and eliminated from practice. Simultaneously, effective measures must be adopted for the speedy development of instrument-building facilities in those branch institutes where such facilities are weak and do not come up to required standards.

The questions brought up in this article do not of course, exhaust the multiplicity of problems present in the activities of research establishments. Pronouncements by scientific and industrial workers in the press will promote a more thorough understanding of these problems and the discussion will provide methods for solving them.

The fundamental purpose of this article, then, is to emphasize the need for and the possibility of a sharp and expeditious increase in the effectiveness of the operations of branch scientific research institutes by the solution of a number of accumulated organizational problems.

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